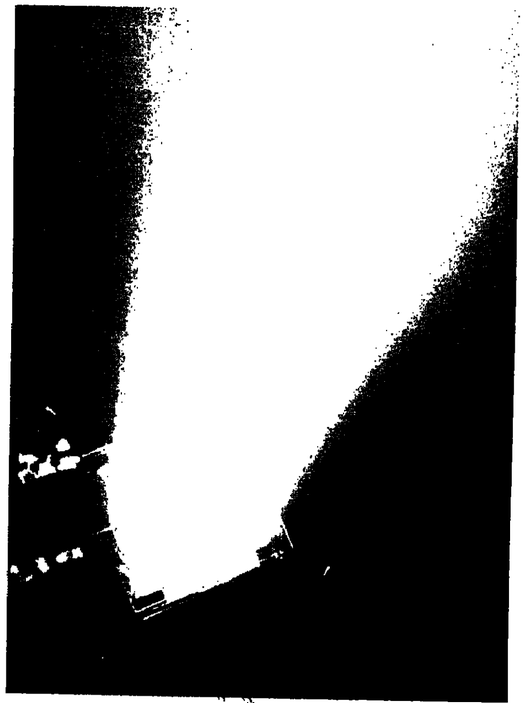

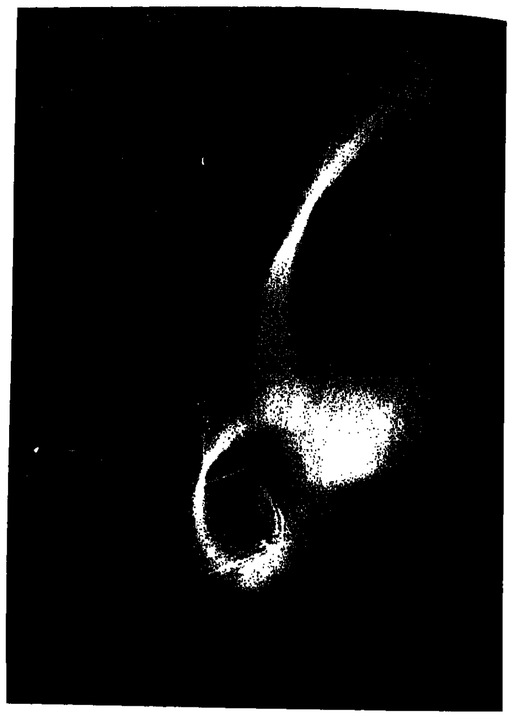

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EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION VOL. 62, NO. 38, PAGES 673-680 SEPTEMBER 22, 1981

Particles and Fields—Magnetosphere

5715 Electric Fields
A CATALYTIC INVESTIGATION OF ENERGY FLUX AND BIMODAL POTENTIAL DROP IN ACCEL ELECTRON [illegible]
J. L. Roeder (Southwest Res. Inst., P. O. Drawer 28510, San Antonio, TX 78284) and J. D. Kurth

A detailed relationship between auroral electron energy flux (ef) and the inferred accelerating potential drop (VI) for accelerated Maxwellian distributions has been derived by R. Rankin and I. Sandahl. This relationship (ef)^3 has been favorably tested with sounding rocket data by Rankin and Sandahl for the limiting case of eV/kT_e << 1 where T_e is the characteristic energy of the accelerated Maxwellian distributions) and by L. Kepko for a single inverted-V observed by the ISEE 1 satellite. The study reported in this paper has utilized data from Atmosphere Explorer D to extend these studies over the range eV/kT_e >> 1 and for a wide range of latitudes and local times on both nightside and the dayside. Our results show good agreement with the full accelerated Maxwellian model. We have further derived an analytical approximation to the electron energy flux which much better describes the data over the range eV/kT_e > 1 than does the eV approximation. In addition, analyses of individual energy spectra at small and large pitch angles through well-defined inverted-V structures suggest that the altitude of the inferred potential drop maximizes near the center of the inverted-V's. (Inverted-V's, accelerated [illegible])
Geophys. Res. Lett., Paper 1L1317

5715 Interactions between solar wind and magnetosphere
CORRELATIONS BETWEEN SOLAR WIND PARAMETERS AND AURORAL KILOMETRIC RADIATION INTENSITY
D. L. Gallagher (Dept. of Physics & Astronomy, U. of Iowa, Iowa City, Iowa 52242) and W. D'Angelo

The relationship between solar wind properties and the intensity of energy into the nightside auroral region, as indicated by the intensity of auroral kilometric radiation, is investigated. Fluctuations, as large as three orders of magnitude and with periods related to the solar rotation period, are found in the observed intensity of auroral kilometric radiation. Correlations are made with solar wind ion density, bulk flow speed (V_{sw}), total IMF strength (B_{tot}), IMF B_y, $V_{sw}B_y$ electric field, solar wind $V_{sw}B_s$ (where B_s is the southward component of the IMF B_z), solar wind $V_{sw}B_{tot}$ and $V_{sw}B_y$, and the substorm parameter ϵ [$\epsilon = V_{sw}B_{tot}\sin^2(\theta/2)l_0^2$]. The best correlation is between the solar wind bulk flow speed and the intensity of auroral kilometric radiation. For the 203 daily averages examined, a linear correlation coefficient of 0.73 is found. (Auroral kilometric radiation, solar wind, velocity, correlations, magnetosphere).
Geophys. Res. Lett., Paper 1L1240

5733 Magnetic storms
BIRKELAND CURRENTS AS THE CAUSE OF THE LOW-LATITUDE ASYMMETRIC DISTURBANCE FIELD
Nancy U. Crooker (Department of Atmospheric Sciences, University of California, Los Angeles, CA 90024), George L. Siscoe

The low-latitude asymmetric disturbance field, which is so prominent during the developing stage of a magnetic storm, and which traditionally has been attributed to a dusk-to-dawn partial ring current, recently has been interpreted by Nishi et al. (1981) as the result of incomplete cancellation of their computer simulated Region 1 and Region 2 Birkeland currents over local time, with net current flowing into the ionosphere at noon and out at midnight. The new interpretation has the advantage of being based on an observed current system rather than on a hypothetical one. We explore the Birkeland current explanation quantitatively in terms of a simple analytical model, the details of which are given separately in an appendix. The residual current, arises as a result of the divergence of the Hall current at the conductivity discontinuity at the poleward boundary of the auroral oval. This effect rotates the pattern of Region 1 Birkeland currents relative to Region 2 currents and produces the net current at noon and midnight. The model gives a simple expression for the amplitude C of the resulting disturbance at the equator in terms of the polar cap potential Φ and the height-integrated Hall conductivity Σ_H^R in the auroral oval:

$$C(nT) \approx .017\,\Phi\,(kV)\,\Sigma_H^R\,(mho)$$

The equivalent current pattern for the model is presented and compared to the equivalent current pattern for a similar model developed by Vasyliunas for the substorm. Combining the two patterns in a time-dependent model can account for the observed pattern of phase shifting of the low-latitude asymmetry during substorms. (Birkeland currents, partial ring current, substorms).
J. Geophys. Res., Blue, Paper 1A1255

5739 Magnetopause
THE INFLUENCE OF THE INTERPLANETARY MAGNETIC FIELD AND THERMAL PRESSURE ON THE POSITION AND SHAPE OF THE MAGNETOPAUSE
H.C. Zieng (Institute of Space Physics, Academia Sinica, Beijing, China) C.T. Russell and R.J. Walker

An ellipsoidal model is used to represent the location of the dayside magnetopause and to study the influences of the interplanetary magnetic field and thermal pressure on its location. The position and shape of the dayside magnetopause in an unmagnetized cold solar wind can be approximately represented by an ellipsoid of revolution with a constant eccentricity. The size of the ellipsoid, its semi-latus rectum L_0, is inversely proportional to the sixth root of the stream pressure of the solar wind.

The effects of the IMF and thermal pressure on the location of magnetopause are calculated analytically by using the Chapman-Ferraro theory. When the IMF, B_0, is included in the boundary calculation, the changes in the magnetopause size, shape and orientation are inversely proportional to the square of the Alfven Mach number of the solar wind (M_A^2) and depend on the direction of B_0. For B_0 directed along an Archimedian spiral and $M_A > 2.5$, the symmetry axis of the ellipsoid will deflect 5.6° from the sun-earth line to the east of the sun. The changes in the magnetopause size, shape and orientation caused by including the thermal pressure are inversely proportional to the square of the sonic Mach number of the solar wind(M_S^2).

Sufficient to explain the observed slight departure of the magnetotail from the expected aberration due to the earth's orbital motion. There is no requirement, based on the IMF observations to invoke a non-radial solar wind component. Hence our results suggest that little angular momentum is presently being carried away from the Sun by the solar wind. (Magnetopause, magnetosphere, boundary).
J. Geophys. Res., Blue, Paper 1A1165

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Editorial

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Bob Engdahl
President, AGU Seismology Section

News

Research Planned for Marginal Ice Zones

World interest in and awareness of the polar regions has developed at an accelerated pace over the past decade. This interest has stemmed from a variety of factors, including increased resource utilization, increased use of polar seas as shipping corridors, and a growing realization that sea ice must be incorporated into any viable global climate prediction scheme. In the 1970's this interest led to implementation of such programs as the Arctic Ice Dynamics Joint Experiment (AIDJEX) and the Arctic Data Buoy Programs, all of which addressed oceanographic and sea ice problems in the central Arctic Basin.

The more difficult, and possibly more significant, problems remain, however, those concerning the variable extents of the sea ice fields in both hemispheres. These variations occur with the greatest intensity in the marginal ice zones, where the floating ice, oceans, and atmospheres are in continual physical contact and dynamic interaction. This realization led the U.S. National Academy of Sciences (NAS) in 1974 to recommend commencement of theoretical and field programs that would address marginal ice zone problems by the late 1970's. Similar recommendations were adopted by the Global Atmospheric Research Program (GARP) a few years following the NAS statement. Most recently, the World Meteorological Organization has reiterated the significance of the marginal ice zones in influencing climate and has recommended implementation of a study program.

In response to these stated needs, an international team of scientists is in the process of formulating a plan to develop scientific research strategies relevant to the marginal ice zones. Building upon experience gained in large part from AIDJEX and the Data Buoy Programs in the Arctic Ocean, from the Norwegian Sea through the Norwegian Sea Experiment (NORSEX), and from the Bering and Chukchi seas through various programs, these scientists have identified two major research objectives. The first is to develop an understanding of the mesoscale (of order hundreds of kilometers) processes associated with air-ice-water interaction in the marginal ice zones. The second is to understand the dynamics of the large-scale interactions more likely to directly impact global climate.

Planning of an experiment to address the first of these objectives is well under way at the present time. The resulting Marginal Ice Zone Experiment (MIZEX) proposes to utilize a combination of field programs and theoretical analyses to investigate mesoscale interactions between air, ice, and water in the marginal ice zones. Field programs are proposed for the Bering and Greenland seas, each of which is characterized by a different set of oceanic and atmospheric conditions, commencing in 1983. Coincident experiments will also be carried out in the marginal ice zone in the Labrador Sea under the auspices of the Labrador Ice Dynamics Experiment (LIDEX). Scientific problems of particularly high priority include definition of an ice rheology law for the marginal ice zones; identification of the dominant processes for air-sea-water interaction along an ice edge, such as frontal development, eddy formation, and double-diffusive phenomena; and melting and freezing processes and their effects upon the underlying waters. Knowledge of these processes will greatly enhance our understanding of vertical and lateral heat transfer through the marginal ice zones and will contribute substantially to an overall understanding of the roles that marginal ice zones play in global climate dynamics.

This news item was contributed by Robin Muench of SAI Northwest and Norbert Untersteiner of the University of Washington. ⊠

Solar Mesosphere Explorer

The Solar Mesosphere Explorer is an atmospheric research satellite designed to study reactions between sunlight, ozone, and other chemicals in the atmosphere and how concentrations of ozone are transported in the atmosphere in the region from 30-km to 90-km altitude. At press time, the satellite was scheduled to be launched no earlier than October 3 at 7:27 A.M. EDT. At least one year of orbital operation is planned.

The objectives of the Solar Mesosphere Explorer project are:

to provide a comprehensive study of atmospheric ozone and the processes that form and destroy it above 30 km;

to determine what changes occur in ozone distribution as a result of changes in incoming solar radiation;

to measure changes in ozone density distribution in the altitude range of 30–90 km and to determine the causes of those changes;

to simultaneously measure temperature, pressure, water vapor, nitrogen dioxide, near-infrared airglow, and the amount of incoming solar radiation;

to determine what solar-terrestrial correlation exists and the paths that lead to changes in ozone density;

to determine other changes in ozone abundance and distinguish them from changes caused by the sun.

Five instruments will simultaneously monitor ozone and minor atmospheric constituent quantities, water vapor abundance and temperature, and the amount of incoming solar radiation to determine the role each plays in ozone production and distribution throughout the mesosphere. Scientific data from the mission will help to develop models for ozone production and depletion on a global scale.

(The mesosphere is the region of the atmosphere between 30-km and 80-km altitude, i.e., above the stratosphere and below the ionosphere. Radiation of short wavelength in that region causes a variety of photochemical reactions; the most notable is creation of a layer of ozone that effectively absorbs solar ultraviolet radiation and causes a warm layer at about 30-km altitude.)

The experiments are

- an ultraviolet ozone spectrometer—to measure ozone (O_3) between 40-km and 70-km altitude;
- a 1.27-m spectrometer—to measure ozone between 50-km and 90-km altitude and hydroxyl (OH) between 60-km and 90-km altitude;
- a nitrogen dioxide spectrometer—to measure NO_2 between 20-km and 40-km altitude;
- a four-channel infrared radiometer—to measure temperature and pressure between 20-km and 70-km altitude and water vapor and ozone between 30-km and 65-km altitude;
- a solar ultraviolet monitor—to measure incoming radiation from the sun. ⊙

NSF FY1982 Update: Support for Basic Research

When the Appropriation Committees of the House of Representatives and the Senate meet in conference this month, discussion of the Astronomical, Atmospheric, Earth, and Ocean Sciences (AAEO) sections of the National Science Foundation (NSF) will be limited. Both the House and the Senate committees made some slight increases to the Office of Management and Budget requests, and the program by program agreement between the two was unusual.

The House appropriation bill, H. R. 4034, provides $70 million over the administration request of $1033.5 million. Of the increase, $44.9 million was added in the area of research and related activities and $25.1 million for science and engineering education.

The Senate version of the appropriations bill is similar, containing an increase of $14 million over the administration request. The increases in the Senate's version emphasized support for foreign programs, for 2- and 4-year college instrumentation requests, and for science education activities, especially in the form of support for graduate study.

The overall AAEO budget request is increased by approximately $7–8 million, according to a spokesman in the

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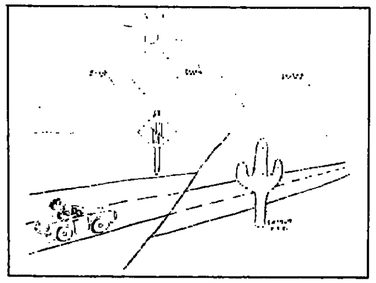

NSF Congressional Liaison Office. The breakdown alter the increase is approximately $63.8 million for astronomy, $73.2 million for atmospheric sciences, $49.3 million for ocean sciences, and $32.1 million for the earth sciences. It appears almost certain that the ocean margin drilling program will be funded as requested; the House-Senate conference on this section of the NSF budget request is predicted to result in little or no change, according to NSF sources.

An unknown factor in the FY1982 budgetary procedure is possible change in NSF authorization by either the House or the Senate. Further overall budget cuts by the Administration before the FY 1982 budget is finally approved could also affect the totals.—*PMB*

Geophysical Events

This is a summary of *SEAN Bulletin, 6*(8), August 31, 1981, a publication of the Smithsonian Institution. The complete bulletin is available in the microfiche edition of *Eos*, as a microfiche supplement, or as a paper reprint. For the microfiche, order document number E81-008 at $1.00 from AGU, 2000 Florida Avenue, N.W., Washington, D.C. 20009. For reprints, order *SEAN Bulletin* (give dates and volume number) through AGU Separates: $3.50 for the first copy for those who do not have a deposit account; $2 for those who do; additional copies are $1.00. Orders must be prepaid.

Volcanic Events

Mt. St. Helens (Washington): Lava extrusion adds new lobe to composite dome (see special report in *Eos, 62* (38), 675; entire article reproduced).

Krafla (Iceland): Pattern of inflation changes.

Asama (Japan): Earthquake swarm but no eruption.

Sakurazima (Japan): Explosions increase.

Kilauea (Hawaii): More information on SW rift intrusion.

Paluweh (Rokatenda) (Indonesia): Lava dome destroyed; pyroclastic flows (entire article reproduced).

Langila (New Britain): Ash and incandescent tephra ejection, then explosions and seismicity decline.

Manam (Bismarck Sea): Incandescent lava, glow, sounds.

Arenal (Costa Rica): Lava flows and incandescent tephra; lava dome obstructing active vent deflates.

Poás (Costa Rica): Incandescent fissures; steam explosions; harmonic tremor and shallow discrete events.

Krafla Caldera, Myvatn Area, Iceland (65.71°N, 16.75°W). Inflation at Krafla resumed as the January 30 to February 4 fissure eruption ended (see *SEAN Bulletins, 6,* (1–2)) and has continued through early September. Previous periods of inflation had been characterized by a single center of uplift beneath the caldera, but data gathered by tiltmeters since February 4 has been more complex and may indicate multiple centers of uplift. Because of the changed pattern of inflation, the rate of magma inflow from depth can no longer be calculated nor can the timing of future deflation events or eruptions be predicted.

Information contact: Karl Grönvold, Nordic Volcanological Institute, University of Iceland, Reykjavik, Iceland.

Paluweh (Rokatenda) Volcano, Lesser Sunda Islands, Indonesia (8.32°S, 121.71°E). All times are local (GMT + 8 h). Explosive activity at Paluweh began in November 1980 and continued intermittently through January. After explosions on January 31, a new lava dome was observed in the active vent, on the NNE upper part of the volcano (see *SEAN Bulletin, 6* (1–2)). No pyroclastic flows were observed during the growth of the dome (although some 'sliding' occurred), but it generated blasts of hot air felt by residents of a flank village. The villagers were evacuated by the end of February, after the Volcanological Survey of Indonesia had issued a volcanic hazard warning. By July, the lava dome was 200 m high, its volume exceeded 8.5×10^6 m^3, and its summit had become the highest point on the volcano at 875 m above sea level. Explosive activity resumed on September 5 between 2010 and 2105, producing a 1-km-high plume. This activity was followed by the destruction of the lava dome. Pyroclastic flows and nuées ardentes d'avalanche moved downslope, depositing 5–20 cm of tephra at one village and starting fires at 36 structures, including a church and five shelters, at a second village. Because residents had previously been evacuated, there were no casualties. Since the destruction of the dome, the three-component seismograph monitoring the volcano has recorded shallow earthquakes that the Volcanological Survey of Indonesia believes may be generated by sliding from remnants of the dome.

Information contacts: A. Sudradjat, director, and L. Pardyanto, senior volcanologist, Volcanological Survey of Indonesia, Diponegoro 57, Bandung, Indonesia.

Meteoritic Events

Fireballs: Algeria; Australia (3); Czechoslovakia; Italy (2); Saudi Arabia; South China Sea; Connecticut and Texas.

Earthquake

Date	Time, GMT	Magnitude	Latitude	Longitude	Depth of Focus	Region
Aug. 13	0258	5.5 M_s	44.86° N	17.33° E	9 km	NW Yugoslavia

Information contact: National Earthquake Information Service, U.S. Geological Survey, Stop 967, Denver Federal Center, Box 25046, Denver, Colorado 80225 USA.

Geophysicists

Twelve AGU members are candidates for various offices in the annual elections of the American Association for the Advancement of Science (AAAS).

J. Tuzo Wilson, AGU president and director general of the Ontario Science Center, is running for the AAAS Board of Directors. He is one of four candidates; two will be elected.

Kristine B. Katsaros, research associate professor at the University of Washington and *Eos* associate editor, is vying with *Hans Panofsky*, Evan Pugh professor of atmospheric science at the Pennsylvania State University, for the office of chairperson-elect of the Atmospheric and Hydrospheric Sciences section of AAAS. Competing for the member-at-large position of the same section are *H. Frank Eden*, senior science associate in the National Science Foundation's Directorate for Astronomical, Atmospheric, Earth, and Ocean Sciences, and *Barry Saltzman*, professor of geophysics at Yale University and former associate editor of the *Journal of Geophysical Research*.

Four AGU members are in contention for the two positions on the electorate nominating committee of the Atmospheric and Hydrospheric Sciences section: *William R. Holland* (senior scientist and head of the oceanography section at the National Center for Atmospheric Research), *Andrew P. Ingersoll* (professor of planetary science at the California Institute of Technology and a member of the Voyager science team), *Clayton A. Paulson* (professor of physical oceanography at Oregon State University), and *Warren M. Washington* (head of the climate section at NCAR).

Clark R. Chapman, at the Planetary Science Institute in Tucson, Ariz., is a candidate for member-at-large of the Astronomy section committee of AAAS. *James Frazier Davis* is running for member-at-large of the Geology and Geography section committee. He is a state geologist and chief of the Division of Mines and Geology for California. *Randall W. Bromley*, at the University of Massachusetts at Amherst, is in contention for the office of member of the electorate nominating committee of the Geology and Geography section.—*BTR*

New Publications

Manual of Photogrammetry, 4th ed.

C. C. Stama (Ed.), American Society of Photogrammetry, Falls Church, Va., xv + 1056 pp., 1981, $59.95.

Reviewed by Clive S. Fraser

Since it was first published in 1944, the *Manual of Photogrammetry* has remained perhaps the most complete handbook of the science of photogrammetry. With the publication of this the fourth edition of the manual, the tradition of providing a comprehensive coverage of the latest theoretical developments, techniques, instruments, and procedures continues.

In the 14 years since the publication of the third edition, significant technological advances have occurred in photogrammetry. Instruments and techniques, which were in various stages of their infancy in the mid-1960's, have been developed into regular production tools; analytical plotters and orthophotography readily come to mind. Without doubt, the greatest advances in photogrammetry over the past decade or so have been in the area of analytical methods. Developments in digital rectification, aerial triangulation, and general automation of photogrammetric processes have paralleled advances in a wide variety of related disciplines ranging from computer technology to the mathematics of estimation and error theory.

The compilation of a handbook for the science of photogrammetry strikes one as an awesome task. Indeed, this fourth edition of the manual was about 5 years in the preparation stage. Contributions were made by nearly 100 authors, including many well-chosen experts drawn from the international photogrammetric community. The very fact that so many authors have been called upon to contribute to this volume indicates the broad scope of present day photogrammetry. Whereas early editions of the manual concentrated almost exclusively on photogrammetric aspects of topographic mapping, significant portions of the latest edition have been given over to newer, burgeoning fields of the science such as nontopographic and satellite photogrammetry.

In scanning the table of contents of the manual and comparing it to that of the third edition, numerous chapter and section headings can be seen to be the same. However, this is misleading. The manual has been substantially rewritten; even the history of photogrammetry, summarized in chapter 1, has been further expanded. Topics covered in the third edition that were deemed to be outdated have been deleted—this process could have been carried a little further—and other sections shortened, combined, and updated to reflect better the current state of the art in photogrammetry.

The manual comprises 19 chapters, the first of which contains an overview of just what photogrammetry is, where the science has been, and where it is headed, along with an account of the products and problems of photogrammetry, and a very readable historical summary. Chapter 18 covers educational and professional aspects, and the last chapter provides a comprehensive 'dictionary' of photogrammetric terms and symbols. The remaining 16 chapters are devoted to the theory, instruments, and techniques of photogrammetry. These chapters are said to be ordered in the sequence that one would encounter in the application of photogrammetry, though considering the diverse fields within the science it is unlikely that the reader would wish to cover the material in each and every chapter leading up to his topic of interest.

Chapter 2 details the basic mathematics of photogrammetry. The coverage includes the geometry of the imaging process, aspects of linear estimation and error theory, least squares adjustment, and mathematical and algorithmic formulations for photogrammetric block adjustment. The last of these topics is also expounded upon in three other chapters. This chapter serves as a good introduction of the treatment of analytical camera calibration presented in chapter 4. Many aspects of aerial and close-range camera calibration are closely interrelated to the design and aberration characteristics of lens systems, and on the topic of photogrammetric optics chapter 3 provides a thorough treatment.

General considerations of the data acquisition phase of a photogrammetric project are discussed in chapters 5–8, with the emphasis being on topographic mapping projects. The first of these chapters covers, amongst other topics, types and uses of aerial photography and factors affecting its procurement. Properties of photographic materials and features of film processing and quality are presented in chapter 8. Chapter 7 concerns the economics of planning and executing a photogrammetric project, in addition to the usual material on flight planning. Field surveys for photogrammetry are covered in chapter 8. Following the sections on geodetic datums for mapping, mapping coordinate systems, map projections, and control surveys is a section entitled 'Photogrammetric Geodesy.' I must confess that this terminology was new to me and seemingly also to those who compiled chapter 19 since 'photogrammetric geodesy' does not appear in the list of definitions of photogrammetric terms. Perhaps geodetic (or cadastral) surveying by phototriangulation or photogrammetric positioning are better descriptions of what is entailed. This technique for control densification is becoming increasingly popular, and the account of the method would have been better placed in the chapter on aerotriangulation, chapter 9.

The chapter entitled 'Aerotriangulation' contains a substantial amount of new material in addition to that drawn from two chapters of the third edition of the manual. The discussion of mechanical and analog instrument triangulation has been considerably condensed, whereas the description of various facets of analytical phototriangulation has been expanded and updated. The fundamental mathematical models of both independent model and bundle block adjustment are detailed, there is a useful section on the theoretical accuracy of block adjustment, and the concepts of self-calibration and combined block adjustment incorporating data from auxiliary sensors are outlined. Chapter 9 should serve as a particularly useful reference on the subject of aerotriangulation. Understandably, however, some topics of current research interest are omitted from the chapter (e.g., blunder detection and reliability theory as related to phototriangulation).

Chapters 10, 11, and 12 deal with stereoscopy, double projection direct-viewing and paper print plotting instruments, and optical-mechanical stereoplotters, respectively. Essentially, these chapters of the manual are updated versions of the corresponding sections in the third edition. New aspects of stereoscopy were worthy of inclusion, but the material presented in chapter 11 could have undergone further condensation. Chapter 12 principally comprises a summary of analog stereoplotters that are either currently available on the market or still in commercial use, a very comprehensive list indeed.

It is noted in the chapter on automation of the photogrammetric process, chapter 13, that Helava's innovative analytical plotter concept, first presented in 1957, was met with a large degree of indifferent interest by the photogrammetric community. Whereas this is certainly no longer the case, the analytical plotter has not enjoyed wide commercial acceptance, in spite of the proven flexibility and accuracy potential of this digital photogrammetric system. Chapter 13 contains descriptions of seven analytical plotter systems. Unfortunately, each of these accounts reads somewhat like a manufacturer's product brief and is short on specifics regarding the merits and demerits of the various hardware and software features of the instrument being discussed. This is in marked contrast to the detailed descriptions of analog stereoplotters in chapter 12. The chapter on automation also includes a section on automatic image correlation that, oddly enough considering the several automated photogrammetric systems available, is less comprehensive than the corresponding account given in the third edition. Another section worthy of expansion is that covering the digital mapping approach, which employs direct digitization on analog stereoplotters. For many topographic mapping companies, such systems offer a lower cost alternative to analytical plotters.

Rectification forms the subject of chapter 14, the emphasis being on analytical methods. Following on logically from this is a chapter on orthophotomaps, aerial mosaics, and instruments for orthophotography.

Principally as a result of the increased flexibility and accuracy afforded by analytical methods, photogrammetry has evolved from a topographic mapping tool into a precise noncontact three-dimensional measurement technique that nowadays finds application in 'nontopographic' areas such as engineering, industry, and bio-medicine. With the exception of one section on on-line analytical photogrammetry, the contents of chapter 16 have been drawn from the *Handbook of Non-Topographic Photogrammetry*, also published by ASP. This chapter is well put together and covers close-range, underwater, and terrestrial photogrammetry; X ray photogrammetric, holographic, and scanning electron microscope systems; and Moiré topography. One conspicuous omission from the chapter is the rigorous bundle adjustment approach to close-range and terrestrial phototriangulation. Fortunately, such an account is introduced in chapter 2, with further details being given in the section on analytical camera calibration in chapter 4.

The last chapter of a technical nature is a particularly impressive one. Chapter 17 deals with satellite photogrammetry, a field that was given major impetus by the lunar mapping projects of the Apollo missions and which should further advance with the space shuttle program. Among the topics covered in this chapter of nearly 100 pages are accounts of orbit geometry and basic orbital dynamics, stellar reference coordinate systems, the spacecraft mode of analytical phototriangulation, and descriptions of past and future space programs that have a photogrammetric content, be it for topographic mapping of the earth or establishing geodetic control on the moon. To my knowledge, this chapter represents the first comprehensive place of literature on the many facets of satellite photogrammetry.

Considering the magnitude of the editorial task involved in preparing the manual it is not surprising that the volume contains a number of shortcomings. The index is sadly deficient in a number of areas (e.g., analytical relative orientation is described in detail in chapters 2 and 9; yet neither section appears in the index), the odd reference does not appear in the appropriate bibliography, and on one occasion a figure referred to is missing. There is considerable duplication; take, for example, the number of times the differential form of the collinearity equations is presented. However, to cut down on duplication would perhaps have reduced continuity adversely.

In summary, the manual is an invaluable source of useful photogrammetric information. I would strongly recommend this volume both to practising photogrammetrists and to those who wish to obtain either a broad overview of photogrammetry or a detailed account of a particular instrument, technique, or methodology employed in the science.

Clive S. Fraser is with the Division of Surveying Engineering, The University of Calgary, Calgary, Alberta, Canada.

Classified

EOS offers classified space for Positions Available, Positions Wanted, and Services, Supplies, Courses, and Announcements. There are no discounts or commissions on classified ads. Any type that is not publisher's choice is charged for at display rates. EOS is published weekly on Tuesday. Ads must be received in writing on Monday 1 week prior to the date of the issue required.

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For special rates, query Robin Little, 800-424-2488.

POSITIONS AVAILABLE

Geophysicist/Geologist: The University of Texas at Austin, Institute for Geophysics. Four research scientist positions are now available at the University of Texas Institute for Geophysics in the fields of marine geophysics, tectonics, seismic stratigraphy, seismic reflection techniques and data processing, ocean bottom seismometer (OBS) and other seismographic instrument design and development, earthquake seismology, and lunar and planetary seismology.

The Institute maintains a modern dockside facility at Galveston, Texas (Galveston Marine Geophysics Laboratory), where a new marine building will be built next year. There is also a component of the Institute based in Austin. The Institute has a modern computer facility for processing and analyzing geophysical data and will be obtaining a new VAX interactive computer system early next year. The Institute maintains two research vessels, the R/V IDA GREEN and the R/V FRED H. MOORE, which have capabilities for conducting marine geophysical surveys including the collection of magnetics, multifold seismic reflection data (48-channel), sonobuoy data, and OBS refraction and earthquake data. This two-ship capability offers the exciting opportunity to conduct two-ship seismic experiments. In addition, the Institute operates extensive seismographic networks in several Central American and Caribbean countries. The Institute maintains close ties with the staff and facilities of the Department of Geological Sciences, which include modern radiometric, isotope, and paleomagnetic laboratories.

A Ph.D. degree is required, preferable in Geology or Geophysics. Salaries are negotiable depending upon experience and qualifications. The person must have the ability and desire to work on group projects, conceive and initiate new projects, collect and reduce data, and publish the results. If you are interested in this excellent opportunity to pursue a challenging career in the forefront of geophysical research in an academic setting, please send your qualifications and references to:

Director
The University of Texas
Institute for Geophysics
Galveston Marine Geophysics Laboratory
700 The Strand
Galveston, Texas 77550.

The University of Texas is an equal opportunity/affirmative action employer.

Engineering Geologist/Geophysicist. The Department of Geological Sciences, University of Saskatchewan, has a vacant tenurable position in engineering geology/geophysics. Applicants should be qualified to teach undergraduate and graduate courses and to conduct research in engineering geology. A background in structural geology may be appropriate. Well-equipped facilities are available for research in rock mechanics, fluid flow through porous media, acoustic, and electrical properties of rocks, and permafrost. Good opportunities exist for joint research with qualifications and experience. Send applications, detailed personal resume including the names of at least three referees, and other supporting data to Dr. W.G.E. Caldwell, Head, Department of Geological Sciences, University of Saskatchewan, Saskatoon, Saskatchewan, S7N 0W0.

Please note: until November 15, 1981 consideration will be given only to applicants who are Canadians or landed immigrants, after that date all applications will be considered.

Research Position in Chemical Oceanography. California Institute of Technology, Division of Geological and Planetary Sciences. The position of research fellow is being offered at Caltech for research in oceanography. Investigation of the isotopic composition of neodymium and rare earth abundances in sea water and sediments is now being carried forward. The mechanism of injection of REE into sea water will be studied. The differences in $^{143}Nd/^{144}Nd$ in various water masses [Piepgras *et al.*, Earth and Planet Sci. Lett. *45*, 223–236 and Piepgras and Wasserburg, Earth and Planet. Sci. Lett *50*, 128–138 (1980)] is now being carried forward as an exploratory venture in order to determine the origin and chemical behavior of REE in the ocean and the potential use of $^{143}Nd/^{144}Nd$ as a tracer. The laboratory facilities for sample preparation and analysis are fully functional and will be available. Applicants should have training in oceanography and a good perspective on general physical oceanographic models.

Send resume and references to Professor G. J. Wasserburg, Lunatic Asylum, California Institute of Technology, Pasadena, CA 91125.

Caltech is an equal opportunity/affirmative action employer (M/F/H).

Economic Geologist, University of Iowa. The Department of Geology invites applications for a tenure track position in economic geology. Appointment will be at the assistant professor level, beginning in August 1982. Applicants should be field oriented with primary research interests in the chemistry of ore deposits. Experience in industry and with modern techniques in geochemistry, computers, and applied mathematics would also be desirable. Candidates should aim to develop a strong research program, taking advantage of companion programs here in mineralogy and petrology, structural geology, geophysics, and remote sensing. Teaching duties will include introductory and advanced courses which will provide students with broad training in economic geology. PhD degree is required at time of appointment.

The Department shares its Geology building with the State Geological Survey. Equipment includes X-ray diffractometers, chemical lab, A.A., automated microprobe, S.E.M., microscopes, cathodoluminescope, geophysics and remote sensing facilities, and in-house computer terminals. The Department has 120 undergrad majors and 60 graduate students. The University, a Big Ten school centrally located in the Midwest, is situated on the scenic Iowa River in a community of 60,000 with a high quality of life.

Applications desired by end of December 1981. Salary minimum of $25,000.

To apply, send complete biography and names of three references to Robert S. Carmichael, Department of Geology, University of Iowa, Iowa City, Iowa 52242

The University of Iowa is an equal opportunity/affirmative action employer.

Atmospheric Scientist/Oceanographer Position: The Joint Institute for the Study of the Atmosphere and Ocean, University of Washington. Atmospheric scientist oceanographer needed to undertake analysis of interannual and interdecadal climate-related fluctuations in the ocean and atmosphere as revealed by marine surface observations from ships of opportunity and island stations.

Applicants should show evidence of published work on related topics and be adept at eliciting dynamical properties from the analysis of large data sets.

The position is offered through the Joint Institute for the Study of the Atmosphere and Ocean, a cooperative research institute between the University of Washington and the National Oceanic and Atmospheric Administration. The work will be carried out in conjunction with scientists at the University and at the NOAA Pacific Marine Environmental Laboratory, which is housed on the University campus.

Appointment is for one year, with a possibility of renewal for subsequent years up to a three-year term. Salary is negotiable, depending on qualifications and experience.

To apply or request further information, write to Director, J.I.S.A.O., Department of Atmospheric Sciences, AK-40, University of Washington, Seattle, WA 98195 U.S.A. Applications should include resumé, bibliography, and two letters of recommendation. Closing date November 15, 1981.

An equal opportunity/affirmative action employer.

Seismologist. Applications are invited for a postgraduate research position in seismology at the Scripps Institution of Oceanography. Applicants specializing in all areas of seismology will be considered, although preference will be given to recent graduates interested in seismic wave propagation, particularly as applied to the oceanic environment and digital signal processing. The position has a duration of one year, with the possibility of extension to two years, and an annual stipend of $18,960. Please send resume and three references to either Dr. Thomas H. Jordan or Dr. John Orcutt, A-015, Geological Research Division, Scripps Institution of Oceanography, La Jolla, CA 92093, prior to 1 December 1981.

Scripps Institution of Oceanography, University of California, San Diego is an affirmative action/equal opportunity employer.

Nominations for AGU Fellows and Awards

November 15 is the deadline for nominations from the membership for AGU Fellows and December 15 for awards for 1982. Nominations for Fellows must be made on forms available from the AGU office. Nominations for medalists and awardees require only a letter of nomination and supporting material. The Bowie Medal, Ewing Medal, Horton Medal, and Macelwane Award committees are accepting nominations for 1982 at this time.

American Geophysical Union
2000 Florida Avenue, N.W.
Washington, D.C. 20009

Physical Oceanographer

$A24,951–$A33,616 pa

CSIRO Marine Laboratories
Division of Oceanography
Sydney NSW, Australia

CSIRO has a broad charter for research into primary and secondary industry areas. The organization has approximately 7400 employees—2500 of whom are research and professional scientists—located in divisions and sections throughout Australia.

GENERAL: In March 1981, the CSIRO Division of Fisheries and Oceanography was formally separated into a Division of Fisheries Research and a Division of Oceanography. These divisions collectively form the CSIRO Marine Laboratories, and are Australia's principal marine laboratories, employing about 200 scientists and support staff. The main laboratory is in Sydney, and there are smaller laboratories in Brisbane and Perth.

Depending on Parliamentary approval, the Sydney activities will be transferred to new laboratories to be constructed on a deep waterfront site in Hobart, Tasmania. Appointees must be prepared to transfer to Hobart at any time after December 1982. The Australian Government has also agreed to the acquisition by CSIRO of a modern oceanographic ship to replace the presently chartered 'Sprightly.'

DUTIES: To be responsible for establishing a receiving station for High Resolution Picture Transmission data from the US NOAA series of satellites to supply data to various CSIRO Divisions and to outside users. The appointee will undertake oceanographic research using these data and advise CSIRO on further applications of satellite remote sensing to oceanography.

QUALIFICATIONS: A Ph.D. in physics or equivalent qualifications with substantial research experience in physical oceanography or closely related geophysical fields. Experience in electronics and computer data reduction, the use and analyses of satellite imagery for oceanographic studies, and the research programs of NASA would be an advantage. The ability to work at sea would also be an advantage.

TENURE: Indefinite with superannuation.

APPLICATIONS: In writing, quoting reference A1459, giving full personal particulars including details of qualifications and experience, copy of academic transcript and the names of at least two professional referees should reach:

The Chief
Division of Oceanography
CSIRO
P.O. Box 21
Cronulla NSW 2230
AUSTRALIA

DEADLINE: October 12, 1981.

CSIRO

Physical Oceanographers

(2 positions)
$A19,662–$A28,564 pa

CSIRO Marine Laboratories
Division of Oceanography
Sydney NSW, Australia

CSIRO has a broad charter for research into primary and secondary industry areas. The organization has approximately 7400 employees—2500 of whom are research and professional scientists—located in Divisions and sections throughout Australia.

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The interests of the Division in physical oceanography include continental shelf dynamics, mixed layer and upwelling dynamics, air-sea interaction, ocean circulation and boundary currents, the interpretation and application of satellite data, numerical modelling and geophysical fluid dynamics.

DUTIES: The appointees will initiate and conduct research within these fields and in relation to existing or future programs. On occasions, they may be expected to participate in or to lead research vessel cruises.

QUALIFICATIONS: Successful applicants would normally hold a Ph.D. in physical oceanography, geophysical fluid dynamics or some other relevant discipline and should be able to demonstrate substantial research aptitude and achievement commensurate with their experience.

TENURE: Fixed term appointments of 3–5 years. Superannuation benefits available.

APPLICATIONS: In writing, quoting reference A1576/1644, giving full personal particulars including details of qualifications and experience, copy of academic transcript and the names of at least two professional referees should reach:

The Chief Division of Oceanography
CSIRO
P.O. Box 21
Cronulla NSW 2230
AUSTRALIA

DEADLINE: October 12, 1981.

CSIRO

Applications are invited for a newly created

CHAIR IN GEODYNAMICS AND TECTONICS

University of Uppsala, Sweden

Closing date: October 30, 1981.

It is expected that the applicants are competent in essential parts of the research field, which comprises the physical processes involved in the dynamic evolution of the earth's crust and mantle. Structural geology, the analysis of deformation processes and the study of the rheological properties of rocks are important components of this field of research. Applications of experimental and theoretical models are of paramount significance for the interpretation of complex geological structures.

Laboratory facilities for experimental modelling are well developed at the department.

Besides research the professorship involves sponsoring graduate students and giving advanced courses in his field.

Current starting salary: 140 000 Sw. Kr. per year.

Applications, including four copies of curriculum vitae and published papers (as well as unpublished manuscripts), should be addressed to:

The Swedish Government
Registrar
University of Uppsala
Box 256, S-75105
Uppsala, Sweden.

AIR FORCE GEOPHYSICS LABORATORY

CHIEF SCIENTIST

Air Force Geophysics Laboratory invites applications for the position of chief scientist located at Hanscom Air Force Base, Massachusetts. The Laboratory is responsible for Air Force research and development in atmospheric physics, solar-terrestrial interactions, ionospheric and stratospheric phenomena, aeronomy, meteorology and weather phenomena, geodesy, gravimetry, seismology and related technologies.

The chief scientist serves as an interface between the scientific researchers of the Laboratory and the outside professional technical community. He recommends promising areas for new research and attempts to enhance the professional stature and reputation of the organization and its scientific output of publications and technical reports.

A candidate should have a record of distinguished achievement in geophysics or atmospheric physics as a research scientist. This position is Air Force Senior Executive Service with a salary range of $52,247 to $57,673, subject to current $50,112 ceiling.

For an application package, call collect:

Mr. Robert Ellerin, (617) 861-2896
or
Mr. Joe Solivan (617) 861-4581.

To be considered, applications must be returned by 30 October 1981.

Equal Employment Opportunity Employer.

Director, Office of Programs and International Affairs. The Office of Research and Development, National Oceanic and Atmospheric Administration (NOAA), has announced the vacancy of Director, Office of Programs and International Activities, located in Rockville, Maryland. The Office of Research and Development is responsible for administering an integrated program of research, technology and advanced engineering development and transfer relating to the oceans, the Great Lakes, the U.S. coastal waters, the lower and upper atmosphere, and the solar and terrestrial environment to increase understanding of the environment and human impact thereon, and thus provide the scientific basis for improved services. The Director, Office of Programs and International Activities, oversees the coordinated development of policies, programs and budgets, and international activities within the Office of the Assistant Administrator for Research and Development. This is an exciting and challenging opportunity for an individual with demonstrated knowledge of (1) oceanographic, meteorological, environmental, physical and/or engineering sciences (including at least 24 semester hours in physical science and/or closely related engineering science at the college level or above), or (2) program analysis techniques and methods involving broad experience in scientific and technological programs related to the oceans or the atmosphere. A knowledge of U.S. policies on treaties and international multilateral and bilateral agreements is desirable.
SALARY: This position will be filled under the Senior Executive Service (SES). Salary could range from $47,889 to $50,112.50 per annum.
APPLICATION: Interested persons should send a U.S. Standard Form 171, Personal Qualifications Statement by October 9, 1981, to Mrs. Susan Clay, Personnel Management Specialist, Office of Personnel, MB/PER11, NOAA, 6001 Executive Boulevard, Rockville, Maryland 20852.
The Department of Commerce, National Oceanic and Atmospheric Administration is an equal opportunity employer.

Position in Reflection Seismology/Rice University, Houston, Texas. The Department of Geology plans to expand its geophysical program. Emphasis will be on reflection seismology. At this time applications are for the first of two open faculty positions. The successful applicant will help in the search for and selection of the second faculty member.
Your main responsibility will be to lead our department into the area of modern reflection seismology. Your main teaching and research interests should be in the acquisition and processing of reflection seismic data. You should also help in developing rigorous undergraduate and graduate curricula, which are supported by the traditional strength of the Math Sciences, Physics, and Electrical Engineering Departments at Rice. Enthusiasm to work with and undertake some joint projects with our geologists is essential.
Our plans are to acquire a computer system configured for high quality data processing. Substantial seed money for this facility is already in hand. Creative cooperation with the oil and geophysical industry in Houston, including a reasonable amount of consulting, is encouraged. Salary will be commensurate with qualifications and experience.
Please send your curriculum vitae, a summary of experience in seismic processing, a statement of research interests, and names of three or more references to Dr. A. W. Bally, Chairman, Department of Geology, Rice University, P.O. Box 1892, Houston, Texas 77001. Application deadline—October 1, 1981.
Rice is an equal opportunity employer.

Director Geodetic Survey, NOAA. The National Oceanic and Atmospheric Administration (NOAA) announces a Senior Executive Service Vacancy for the position of Director, Geodetic Research and Development Laboratory (GRDL) in the National Geodetic Survey, a component of the National Ocean Survey. The duty location is Rockville, Maryland. The salary range is $47,889–$50,112.50 per annum. Duties include providing technical and administrative supervision over employees and activities of GRDL; advising officials on the state of scientific knowledge in geodesy and making recommendations for research and development; exercising scientific and technical knowledge of contributing publications to professional journals and making presentations at national and international meetings; and advising and consulting scientists and executives in improvement of geodesy and related fields. Experience in management of scientific programs, geodesy, and solid earth sciences is required. Apply to: NOAA/NOS-8001 Executive Boulevard, Rockville, Maryland 20852. Attn: MB/PER15:TR
NOAA is an equal opportunity employer.

Faculty Positions: The University of Iowa. The Department of Physics and Astronomy anticipates one or two openings for tenure-track faculty in August 1982. One or more visiting professorships, at any rank, are also expected to be available. Preference will be given to candidates with research activity in the following experimental and theoretical areas: astronomy, astrophysics, atomic physics, condensed matter physics, elementary particle physics, nuclear physics, plasma physics, and space physics. The positions involve undergraduate and graduate teaching, guidance of research students, and personal research. Interested persons should send a résumé, a statement of research interests, and the names of three professional references to Search Committee, Department of Physics and Astronomy, The University of Iowa, Iowa City, IA 52242.
The University of Iowa is an equal opportunity/affirmative action employer.

Faculty Positions. Arizona State University, Department of Geology. Applications are invited for two tenure-track faculty positions, one at the assistant professor level and one at the associate level, beginning in August of 1982. One of these positions requires a candidate with interests in applying modern solid state science to geological phenomena. The selected candidate should develop an active research program and may use the extensive opportunities offered by the Facility for High Resolution Electron Microscopy at ASU. Teaching duties will include undergraduate mineralogy. Candidates for the other position should complement and extend existing strengths in the department. Possible areas include low temperature geochemistry, heavy isotope geochemistry, solid earth geophysics, tectonophysics, and related fields. The ability to use modern techniques in both field and laboratory studies and to integrate diverse approaches is highly desirable. Please send a detailed statement of research and teaching interests and a resume with names of four references to David Krinsley, Department of Geology, Arizona State University, Tempe, AZ 85287, by January 15, 1982.
Arizona State University is an equal opportunity/affirmative action employer.

Senior Faculty Position: Meteorology. Applications and nominations are invited for a senior faculty position in meteorology, at the University of Utah. Eligible applicant will also be considered for chairperson of the department. Candidates must possess a Ph.D. in meteorology or a related discipline. Applicants should have teaching and research experience and be interested in participating in both the graduate and undergraduate programs. Applicants should submit curriculum vitae and names of three professional references to:

Dr. Jan Paegle
Search Committee
Department of Meteorology
University of Utah
Salt Lake City, Utah 84112

Deadline for applications November 30, 1981.
The University of Utah is an affirmative action/equal opportunity employer.

Seismologist. The State University of New York at Binghamton has a vacancy for a seismologist at assistant professor level. Ph D degree holders with research interest in exploration seismology or earthquake seismology with solid theoretical background are welcome to apply.
The successful candidate is expected to teach courses in applied geophysics, time series analysis, wave propagation, etc. Ph.D. with 0 to 5 years of teaching, research and/or industrial experience is appropriate for the position. Salary negotiable and competitive with academic institutions. Position available September 1, 1982.
Please send resume and names of three references to Chairman, Geophysical Search Committee, Department of Geological Sciences, State University of New York at Binghamton, New York 13901.
We are an equal opportunity/affirmative action employer.

Virginia Polytechnic Institute and State University: Senior Research Associate. Interesting and abundant research and publishing opportunities, including new University-owned MDS-10 VIBROSEIS system, VAX 11/780 computer. Must have experience in theory and application of reflection seismology, and be interested in the application of reflection seismology to the solution of geologic problems.
Send resumes to: Dr. D. R. Wones, Department of Geological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0796.
The University is an equal opportunity/affirmative action employer.

Petrologist Northern Illinois University. Applications are invited for a tenure track position in igneous or metamorphic petrology at the assistant or associate professor level beginning either January, 1982 or August, 1982. A Ph.D. degree is required and post-doctoral research experience is preferred. The successful candidate will be expected to pursue an active research program, teach at the undergraduate and graduate level, and direct Masters and Ph.D. graduate research work. Facilities housed within the Department of Geology include a fully automated electron microprobe, SEM, solid-source and gas-source mass spectrometers, AA, XRD, and XRF. To receive full consideration, please send resume, statement of research interests, and the names of three references, by November 1, 1981, to Jonathan H. Berg, Search Committee Chairman, Department of Geology, Northern Illinois University, DeKalb, Illinois. 60115.
An equal opportunity/affirmative action employer.

Postdoctoral Awards in Ocean Science and Engineering. Woods Hole Oceanographic Institution invites applications for 1-year postdoctoral scholar awards from new and recent doctorates in fields of biology, chemistry, engineering, geology, geophysics, mathematics, meteorology, and physics, as well as oceanography. Recipients of awards are selected on a competitive basis, with primary emphasis placed on research promise.
Fellowship stipend is $20,000. Appointees are eligible for group health insurance and a modest research budget. Recipients are encouraged to pursue their own research interests independently or in association with resident staff. Completed applications must be received by February 1, 1982 for 1982–83 awards. Awards will be announced in March. Write for application forms to: Dean of Graduate Studies, P.O. Box E, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543.
Equal Opportunity/Affirmative Action Institution

Faculty Position: Environmental Engineering. Beginning January or September 1982. The position requires undergraduate and graduate teaching and sponsored research activities in the areas of water quality control and water resources. An earned doctorate is required and at least one degree in civil engineering is preferred. Rank will be at the assistant professor level and salary will depend upon qualifications. Apply to: Dr. Lester A. Hoel, Chairman, Department of Civil Engineering, University of Virginia, Charlottesville, Virginia 22901.
An affirmative action-equal opportunity employer

City University of New York, (Brooklyn College): Faculty Positions. The Department of Geology anticipates filling several tenure track positions at Full Professor level (Salary range up to $43,400). Highly qualified individuals will be considered for distinguished appointments at an additional $5,000.
While candidates who have distinguished themselves in any field are welcome to contact us, we are particularly interested in openings in energy resources (coal petroleum), exploration geophysics, environmental geology or hydrogeology, coastal sedimentology, economic geology.
Successful applicants will be required to institute an active research program, supervise Master's and Ph.D. theses. Nominations and applications with current vitae should be sent to: Dr. S. Bhattacharji, Chairman, Dept. of Geology, Brooklyn College of City University of New York, Brooklyn, New York 11210. Positions open until filled.
Brooklyn College, CUNY, is an affirmative action/equal opportunity employer.

Geophysics Position. The Physics Department of the University of New Orleans invites applications for tenure track positions available January 1982 or August 1982. Rank and salary are to be commensurate with experience and training. Candidates with background in geophysics, acoustics or computational physics are especially encouraged to apply. The UNO departments of Earth Sciences and Physics are jointly developing programs and curricula to respond to the demand for graduates in geophysics in the local metropolitan area and in the south central U.S.
The successful applicant can expect collaborative research support from faculty active in signal processing and enhancement techniques and in inverse scattering analysis. Other areas of departmental research involve atomic, molecular, and solid state physics, cryogenic geophysics, hydrodynamics and computational physics. Applicants should send a résumé to Professor J. Murphy, Search Committee, Physics Department, University of New Orleans, New Orleans, LA 70148.
The University is an equal opportunity/affirmative action employer.

Purdue University. The Department of Geosciences invites applications for a faculty position, starting January or July 1982, in the broad field of mineralogy-petrology-geochemistry. A Ph.D. is required and preference may be given to scientists with an established record of research. The Department has an automated electron microprobe, mass spectrometer and laboratory for stable isotope studies, full range of high temperature and high pressure equipment, including furnaces for controlled fO_2 experiments, as well as X-ray equipment. The successful applicant will be expected to participate in both the undergraduate teaching and graduate studies programs, as well as actively engage in research. Rank and salary are open but will be commensurate with qualifications.
Purdue University is a land grant, state supported institution committed to academic excellence, and is an equal opportunity/equal access employer. For further information please contact Dr. Henry O. A. Meyer, Dept. of Geosciences, Purdue University, West Lafayette, IN 47907 (Tel. 317-494-3271)
Closing date for applications is November 10, 1981.

EARTH SCIENCES

The Lamont-Doherty Geological Observatory of Columbia University invites scientists interested in any field of the earth sciences to apply for the following fellowships: two postdoctoral fellowships, each awarded for a period of one year (extendable to two years in special instances) beginning in September 1982 with a stipend of $22,500 per annum. Completed applications are to be returned by January 15, 1982. Application forms may be obtained by writing to the Director, Lamont-Doherty Geological Observatory, Palisades, New York 10964. Award announcements will be made February 28, 1982 or shortly thereafter. The Observatory also welcomes applications from candidates for postdoctoral research associate positions in this discipline.

STUDENT OPPORTUNITIES

Earth Sciences Assistantships and Fellowships. Research assistantships and fellowships are available to graduate students in the earth sciences from the Columbia University Department of Geological Sciences. The awards cover tuition and fees, and provide a yearly stipend of between $6400 and $8180.
Research is carried out at affiliated institutions including the Lamont-Doherty Geological Observatory, the Goddard Institute for Space Studies, and the American Museum of Natural History. Research topics available to students reflect the interests of the more than 300 Ph.D.-level scientists at these institutions and span virtually every area of the earth sciences.
The department encourages applications from students with an undergraduate degree in any of the natural sciences or engineering. For additional information please contact Ms. Ma Lee, Department of Geological Sciences, Columbia University, Lamont-Doherty Geological Observatory, Palisades, New York, 10964.

Graduate Research Assistantships in Physical Oceanography. Opportunities for graduate study with Research assistantship available for students interested in M.S. or Ph.D. programs. A summer program with stipend is open to college juniors. Write: Douglas Caldwell, School of Oceanography, Oregon State University, Corvallis, OR 97331

Tectonophysics Assistantships. Center for Tectonophysics, Texas A & M University, has assistantships available for Ph.D. students in Geology and Geophysics wishing to specialize in applying rock mechanics principles to problems in geotectonics, structural geology, engineering geology, and geophysics. These half-time appointments currently pay $550 per month for beginning graduate students to $675 per month for advanced Ph.D. candidates and include waiver of the out-of-state tuition. Write Dr. M. Friedman, Center for Tectonophysics, Texas A & M University, College Station, Tx. 77843.

Meetings

56th Colloquium of the International Astronomical Union

Introduction

Geodesy, geophysics, astronomy, and astrophysics are all exploiting the unprecedented progress in the accuracy of metric measurements made from space and the earth's surface. Measurements of polar motion and earth rotation, crustal deformation and displacement, satellite and planetary motion, and the positions of stars and quasars are all being refined. These new measurements are providing information on plate tectonics and earth dynamics, the earth's variable rotation, the evolution of the moon and planets, the scale of the solar system and the universe, and the local space-time metric. A common requirement of all these investigations is the necessity of a well-defined coordinate system (or systems) to which all relevant observations, theories, and models can be referred and which can be used as a basis for discussion. In view of the widespread use and interdisciplinary implications of these observations, there is a need for the definition, practical realization, and international acceptance of a suitable coordinate system (or systems) to facilitate such work. The need, the scope of the issues, and the nontriviality of the problem is evidenced by the numerous specialized symposia organized during the past dozen years: Stressa [*Markowitz and Guinot*, 1968], Morioka [*Melchior and Yumi*, 1972; *Yumi, Guinot*, 1968], Morioka [*Melchior and Yumi*, 1972; *Yumi, Guinot*, 1968], Columbus 1971], Torun [*Kaĺaczek and Weiffenbach*, 1974], Columbus [*Mueller*, 1975, 1978], Kiev [*Federov et al.*, 1980], San Fernando [*McCarthy and Pilkington*, 1979], and recently, Warsaw [*Gaposchkin and Kaĺaczek*, 1981]. The Warsaw meeting (September 8–12, 1980) is the subject of this review.

Overview

Recent advances in metric measurements and models, coupled with the understanding of the mobile earth in terms of plate tectonics, require a rediscussion of the principles and methods used for defining terrestrial reference frames and establishing terrestrial reference systems. Earth, satellite, and solar system dynamics require a more careful definition. Galactic and extragalactic reference systems are being redefined. All these reassessments are fundamental, and none is independent of the others. There is also the need to establish conventions and conventional models. For example, astronomers need to establish lunar and planetary ephemerides for general use in published almanacs and prefer to do so consistent with the best understanding of the actual phenomena. The ephemerides and nutation series used for this purpose cannot be revised capriciously. Therefore there is a need to upgrade the system of astronomical and geophysical constants in a planned and judicious way. These meetings serve as a forum for the users (the scientific community among others) to discuss and debate models, observations, data reduction, and interpretation. Further, as these precision metric observations become operational (for example the classical measurement of polar motion and earth rotation will be superseded), the transition to new methods and data sources must be made in a way to preserve the validity of the existing data and allow maximum use of new methods for both the service function and research use of the new data. Finally there is the need for interdisciplinary discussion, in this instance, geodesists, geophysicists, dynamicists, as-

tronomers, and astrometricists have common interests. The logical intersection of these disciplines occurs at these specialized colloquia, and each discipline is invigorated and rejuvenated through this cross fertilization.

The Meeting

Planning for the Warsaw meeting occurred in two phases. First, the organizers (B. Kołaczek and E. M. Gaposchkin), working with the program committee (J. Kovalevsky, I. I. Mueller, and M. Rochester) and other interested scientists, developed a list of problems and questions that would be addressed. This list was circulated to a larger number of colleagues, asking for comment and an expression of interest. Second, from these responses a list of review topics and invited papers was established. The speakers were then chosen. We were gratified that very few individuals were unable to accept. The revised list of questions and problems was circulated to the review and invited speakers with a request to address specific topics as well as any they considered relevant. With this preparation the final program was nicely balanced.

The meeting began with eight papers by I. I. Mueller, P. L. Bender, G. Veis, H. Moritz, E. M. Gaposchkin, J. D. Mulholland, J. Kovalevsky, and K. Lambeck, in that order. These review papers served to identify the issues, display the panorama, and focus the discussion. The remaining time was divided into four parts. Invited and contributed papers were given in each part. The number of papers and the amount of time allotted was arranged to allow for discussion of each paper and for conduct of an open discussion at the end of each part. In this way, formal presentations were combined with discussion and debate. Each discussion leader focused the discussion and provided a resumé for the conference summary given by J. Kovalevsky and I. I. Mueller. The manuscripts were reviewed at the meeting, and changes resulting from the discussion and review were incorporated into the proceedings.

The first part was largely a discussion of theory, observation, and interpretation of polar motion, earth rotation, precession, and nutation. The second part discussed terrestrial coordinate systems established with satellite, space, and classical methods. This included a discussion of dynamical systems for artificial earth satellite motion. The third part, concerned with planetary and lunar reference systems, was basically a discussion of how ephemerides of the planets, minor planets, and the moon are established. The fourth part addressed the establishment of stellar reference systems, the imminent FK5 catalog, extragalactic reference systems, VLBI catalogs and their relation to stellar catalogs, and the forthcoming Hipparchus astrometry satellite. The discussion leaders (M. Rochester, H. Moritz, J. D. Mulholland, and C. Murray) did an excellent job of focusing the discussion and extracting the main issues for the final review.

Discussion and Results

In such a wide-ranging discussion, there were far too many salient points to review here, and the interested reader is referred to the proceedings [*Gaposchkin and Kołaczek*, 1981], which is now available. From this participant's point of view the important conclusions can be summarized as follows:

1) There seems general agreement that only two basic or fundamental systems are needed: a Conventional Inertial System (CIS) that is attached in some 'prescribed way' to extragalactic celestial radio sources and serves as a reference for the motion of a Conventional Terrestrial System (CTS), and a CTS that moves and rotates in some average sense with the earth and is also attached in some prescribed way to a number of dedicated observatories operating on the earth's surface. In the CTS the geometry and dynamic behavior of the earth would be described in the relative sense, while in the CIS the movements of our planetary system (including the earth) and our galaxy could be monitored in the absolute sense.

2) There is need for certain intermediate systems to be used in theoretical calculation in geodesy, astronomy, geophysics, and astrophysics and to aid in the customary decomposition of the transformations between the reference frames of the two fundamental systems.

3) There seems to be no need to use fundamental systems for strain measurements, which are primarily of interest in the study of tectonic motion.

4) There was lack of agreement on what role should be played by the earth's center of mass in defining the CTS.

5) There seems to be general understanding on how the two basic reference systems should be established. An international agreement through the IAU and the IUGG/IAG is necessary. A resolution was passed and subsequently adopted by the IAU and IAG to establish a working group to

> '. . . prepare a proposal for the establishment and maintenance of a Conventional Terrestrial Reference System. This system is to include provisions for the replacement of the presently used terrestrial reference frame (such as the one partially defined by the CIO and the BIH zero meridian), providing continuity and conformance with the IAU 1976 and 1979 resolutions regarding astronomical constants and the theory of nutation, or its possible modification, as well as with the IUGG Geodetic Reference System 1980.'

Specialized symposia such as this have individual motifs which characterize them in later years. Warsaw in September 1980 had a particular spirit of change and uncertainty in the air. This meeting went by with few of the minor irritants which are de rigueur to complain about at breakfast. Our Polish hosts and colleagues provided a forum for spirited and penetrating debate, where we could spend a maximum of time discussing some puzzling problems and fascinating ideas and a minimum of time going through the standard set of rehashed results that can occur in this age of abundant meetings and multitudinous journals. No doubt the proceedings do not reflect the spirited discussion and the insights gained by exposure to neighboring disciplines. They do reflect the concerted effort of many of the contributors to focus their thoughts before the meeting on the set of questions circulated. A number of the contributions were stimulated by the occurrence of the meeting. Perhaps the Warsaw discussions in the fall of 1980 were a transition to a new era. For that we must await the judgement of history.

This meeting report was prepared by E. M. Gaposchkin, with a lot of help from the coorganizer and the program committee.

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GAP

Aeronomy

0460 Tides, waves and winds
NUMERICAL SIMULATION OF SEMIDIURNAL ATMOSPHERIC TIDES
Y. Aso (Radio Atmospheric Science Center, Kyoto University, Gokasho, Uji, Kyoto 611, Japan), T. Nomoyama, and S. Kato

Numerical modelling of the solar and lunar semidiurnal atmospheric tides has been performed by inaching a comprehensive approach which includes both algebraic manipulation and numerical solution of the primitive equation system. The effect of latitudinally varying temperature and associated mean zonal wind in a modelled atmosphere with realistic forcing are successfully incorporated to reproduce tidal variabilities at meteor heights delineated by varieties of radar observations. (Solar semidiurnal tide, lunar tide, simulation, mean wind)
J. Geophys. Res., Blue, Paper 1A1375

Electromagnetics

[illegible] Antennas
THE PHASE CENTER OF A [illegible] ANTENNA
[illegible] University of Technology, Dept. of [illegible], Delft, The Netherlands)

Accurate positioning of earth stations with the aid of the Transit Doppler satellite system relies strongly on a detailed knowledge of the phase center of the receiving antenna. For the idealized model of a [illegible] antenna with an infinitely large, perfectly conducting ground plane, the phase center is computed. The analysis is carried out by using the boundary integral equation method for determining the surface current density on the conducting parts of the configuration. For azimuthal angles between 0° and 60° the change in position of the phase center is found to be moderate. When the azimuthal angle approaches 90° the change is more pronounced. The computed curves could be of value for modelling the phase behaviour of [illegible] antennas, generally used in practice as receiving antennas.
Rad. Sci., Paper 1S1350

0773 Remote sensing
EVALUATION OF ATMOSPHERIC ATTENUATION FROM SMMR BRIGHTNESS TEMPERATURE FOR THE SEASAT SATELLITE SCATTEROMETER
R.K. Moore (University of Kansas Center for Research, Inc., Lawrence, Kansas), I.J. Birrer, E.M. Bracalente, G.J. Dome and F.J. Wentz

To measure the radar backscatter from the ocean with enough accuracy to allow determination of the wind vector, the effect of attenuation in precipitating regions over the sea must be considered. The attenuation can be determined reasonably well from a knowledge of the brightness temperature observed by a microwave radiometer. For the SEASAT this radiometer was the SMMR. Two algorithms were developed to relate radiometric measurements and attenuation and hence to correct the measured values of scattering coefficient. The two algorithms were compared with the best available information on precipitation, but no direct information on attenuation was available. Hence, the basic comparisons reported here are between the wind vectors reported by surface observers and those determined by the SASS measurements with and without correction for atmospheric attenuation. In general the attenuation correction appears to improve the results obtained. However, the "correction" is not as good as it should be because of the differing size of the 18 GHz radiometer footprint and the SASS footprint, and because the scan patterns are different so that averages from several radiometer footprints may be involved in a single SASS correction.
J. Geophys. Res., Green, Paper 1C1395

0773 Remote sensing
INFLUENCE OF DISSOLVED ORGANIC MATERIALS ON TURBID WATER OPTICAL PROPERTIES AND REMOTE-SENSING REFLECTANCE
W. G. Witte, C. H. Whitlock, R. C. Harriss, J. W. Usry, L. R. Poole, W. M. Houghton, W. D. Morris, and E. A. Gurganus (NASA Langley Research Center, Hampton, Virginia)

Results from both field measurements and laboratory simulations are used to assess the effects of dissolved organic materials on turbid-water optical properties. Upwelled reflectance, attenuation, absorption, and backscatter spectral properties at wavelengths from 450 nm to 800 nm are examined in relation to water chemistry. From these data, it is clear that dissolved organic materials decrease upwelled reflectance from turbid waters. Depending on wavelength, the decrease in reflectance is a nonlinear function of concentration with largest gradients at low carbon concentrations. Large increases in absorption coefficient (particularly at blue wavelengths) are observed with increases in dissolved organic material. Changes in backscatter coefficient are moderate indicating minimal changes in particle scattering. Upwelled reflectance is highly correlated with two backscatter-absorption parameters used in certain optical models. Both backscatter-absorption parameters prove to be nonlinear with dissolved organic material concentration change. (Upwelled reflectance, dissolved organic materials, turbid-water, optical properties).
J. Geophys. Res., Green, Paper 1C1305

0773 Remote Sensing
A THEORY FOR NEAR NORMAL INCIDENCE MICROWAVE SCATTERING FROM FIRST YEAR SEA ICE
G. S. Brown (Applied Science Associates, Inc., Apex, NC 27502)

A theory is presented to explain near normal incidence microwave scattering from first year sea ice. The theory is based upon the hypothesis of an abnormal number of relatively large (in terms of wavelength) flat areas on the surface which are all at the same elevation relative to mean sea level. These flat areas are assumed to be randomly located circular spots with random radii. Application of this theory to typical radar altimeter data produces parameter estimates which are in reasonable agreement with the available surface truth. (Remote sensing, rough surface scattering, sea ice, altimetry).
Rad. Sci., Paper 1S1132

Geochemistry

1410 Chemistry of the atmosphere
MEASUREMENTS OF C_2–C_5 HYDROCARBONS OVER THE NORTH-ATLANTIC
J. Rudolph and D.H. Ehhalt (Institut für Chemie 3: Atmosphärische Chemie, Kernforschungsanlage Jülich, Postfach 1913, D-5170 Jülich, FRG)

Latitudinal distributions of ethane, propane, propene and acetylene in air over the Atlantic from 48°N to 4°S are reported. In addition, measurements of saturated and unsaturated hydrocarbons (C_2–C_5) at low latitudes and from 55°N to 80°N are presented.
The mixing ratios of ethane, propane and acetylene were found to vary systematically between a few tenths of a ppb and a few ppb. The alkene and higher alkane (C_4 and C_5) mixing ratios were found to be in the ppt range. The data are discussed with respect to the source distributions and atmospheric lifetimes of the different hydrocarbons. (Hydrocarbons, marine atmosphere, latitudinal distribution).
J. Geophys. Res., Green, Paper 1C1345

1440 Chemistry of the solid earth
PRIMARY AND SECONDARY ALKALI AND HALOGEN ELEMENT DISTRIBUTION IN I.R.D.P. BASALTS FROM EASTERN ICELAND
P.A. Floyd (Geology Department, University of Keele, Staffordshire, U.K.), H. Fuge

Chemical variation in hydrothermally altered basaltic lavas and dikes intersected in Icelandic Research Drilling Project borehole sequence from E. Iceland are described. Three lava groups and two dike groups are recognised at different depths in the drilled section and exhibit trends towards more primitive compositions upwards in the lava pile. Chemical variations reflect both primary features (magma composition, crystal fractionation) and secondary mobilisation during hydrothermal alteration. The latter caused variable alkali and halogen element dispersion (mobility sequences: Rb>K>Li>Na and Cl>F>I), although few systematic trends with increasing hydration are observed. Main effect of alteration was a localised redistribution of mobile elements into stable secondary phases. (Basalts, hydrothermal alteration, Iceland).
J. Geophys. Res., Red, Paper 1B1246

Geodesy and Gravity

1930 High-order harmonics of the gravity potential field and local gravity anomalies
GRAVITY MODEL IMPROVEMENT FOR SEASAT
F.J. Lerch (Geodynamics Branch, Goddard Space Flight Center, Greenbelt, Maryland) J.G. Marsh, S.U. Klosko, R.G. Williamson

Analysis of the data from the Seasat altimeter, a 10 cm precision instrument, requires accurate knowledge of the radial position of the spacecraft for oceanographic applications such as the study of tides and ocean circulation as well as for geodetic applications. Initial orbit determinations using the best available geodetic and force models gave radial errors approaching 5 meters. The dominant source of this radial error was the gravity field model. Improvements in the gravity modeling were made by successively incorporating the Seasat laser and Unified S-Band ground tracking data, the GEOS-3 altimeter data, and finally, the Seasat altimeter data. With the most recent model (a set of spherical harmonic coefficients complete to degree and order 36), Seasat ephemerides have been computed for an orbital arc length of 12 days with an rms radial accuracy of about 70 cm. (Gravity field, potential harmonics, altimetry, satellite geodesy).
J. Geophys. Res., Red, Paper 1B1299

1910 Rotational variations
EARTH ROTATION FROM LUNAR LASER RANGING
R. B. Langley (Department of Earth and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139) R. W. King and I. I. Shapiro

We have estimated the variation of latitude and UT0 from McDonald Observatory lunar laser ranging observations for the period October 1970 to October 1979. The typical formal uncertainties of our values are about 6 milliseconds (mas) and 0.5 milliseconds (ms) of time, respectively. We compared our values of variation of latitude with those derived from pole positions determined using classical astrometric, satellite Doppler and satellite laser ranging techniques for the period July 1976 to November 1978 when data from all of these techniques were available. This comparison shows no evidence for significant high-frequency fluctuations and, in fact, yields the smallest root-mean-square difference of 5.2 mas between the lunar laser ranging and the satellite Doppler values, after smoothing the latter with a Gaussian-shaped smoothing window with a full-width-at-half-maximum of about 70 days. A comparison of our UT0 estimates with those calculated from the Circular D smoothed pole-position and UT1 values published by the Bureau International de l'Heure (1979 system) gives an rms difference of 1.5 ms for the entire nine-year span of the laser ranging data. (Lunar laser ranging, earth rotation, variation of latitude, polar motion)
J. Geophys. Res., Red, Paper 1B1339

Hydrology

3135 Glaciology
THE ROLE OF SUBLIMATION AND CONDENSATION IN THE FORMATION OF ICE SHEET SURFACE AT MIZUHO STATION, ANTARCTICA
T. Fujii (National Institute of Polar Research, Kaga 1-chome, Itabashi-ku, Tokyo 173, Japan) and T. Kusunoki

Three methods were used to determine the sublimation and condensation at Mizuho Station in 1977-1978, that is, direct observations with an evaporimeter filled with ice, and repeated measurements of offset stakes, and indirect estimation using an empirical formula derived from meteorological parameters. A comparison of three methods shows satisfactory agreement especially in the weekly average of sublimation in the 1977-1978 summer, while condensation is insignificantly small. Condensation prevailed from the middle of April to the middle of September and sublimation in the remainder of 1977. The annual amounts of condensation and sublimation in 1977 are estimated to be 0.2-0.6 g.cm^2 and 3.5 g.cm^2, respectively. The daily amount of sublimation showed its maximum of 92 mg.cm^2 on December 22 1977, at the summer solstice. The annual amount of sublimation much affected the annual net accumulation of 5.8 g. The sublimation and condensation contributed in the formation of glazed surface consisting of multilayered ice crusts. This glazed surface is representative in the katabatic wind region in Mizuho Plateau, and the structure of the ice crust reflects the mass balance due to sublimation and condensation on both sides of the crust. Sublimation rate varies with the direction of the sloping faces of sastrugi, being the maximum on the north-facing slope which receives the maximum solar radiation. (Sublimation, condensation, mass balance, ice sheet).
J. Geophys. Res., Green, Paper 1C1341

3150 Precipitation
SECULAR CHANGES IN ANNUAL AND SEASONAL GREAT LAKES PRECIPITATION, 1854-1979, AND THEIR IMPLICATIONS FOR GREAT LAKES WATER RESOURCE STUDIES
F. H. Quinn (Great Lakes Environmental Research Laboratory, 2300 Washtenaw Avenue, Ann Arbor, MI. 48104)

An analysis of annual precipitation over the Great Lakes Basin from 1854 to 1979 indicates two distinct precipitation regimes. The first, a relatively dry regime, lasted from the mid-1880's until the late 1930's. This was followed by a relatively wet regime, which continues to the present. The analysis also indicates that the annual precipitation regime prior to the mid-1880's was similar to the present regime. The change in precipitation appears to be the result of increased precipitation during spring and summer. A continuation of the present wet regime will present many challenges for water resource managers and planners concerned with lake regulation, water supply forecasting, coastal zone management, and water allocation and uses in the Great Lakes Basin. (Precipitation, Great Lakes, climatology).
Water Resour. Res., Paper 1W1168

3150 Precipitation
HYDROCLIMATOLOGICAL CHARACTERISTICS OF ISOLATED SEVERE RAINSTORMS
Stanley A. Changnon, Jr. and John L. Vogel (Illinois State Water Survey, P. O. Box 5050, Station A, Champaign, Illinois)

Intense but very localized severe rainstorms are the most frequent type of flash-flood producing rainstorms in the United States. These storms often go unmeasured because the nation's raingage network is too sparse. A well-measured sample of 32 storms was obtained from operations of dense raingage networks in Illinois. These storms typically last from 3 to 12 hours, affect less than 1000 km^2, and have 1- to 4-hour rainfall totals in excess of 7.5 cm. Area frequency relationships indicate about 40 of these storms occur during each warm season over Illinois, an area of 145,000 km^2. The morphology of one severe isolated rainstorm is described to illustrate the typical conditions. The heavy rains (>17 cm) from this storm fell within both urban and rural regions causing extensive damage. The heavy rain was due to a succession of moderately intense small individual storms that moved across the same region. Real time detection of such storms is possible from careful observations of radar data. (Severe Rainstorms, Hydrometeorology)
Water Resour. Res., Paper 1W1193

3170 Snow and ice
EFFECT OF ASHFALL ON SNOWMELT RATE AT PARADISE, MT. RAINIER, WASHINGTON
Bert E. Brown (Physics Department, University of Puget Sound, Tacoma, Washington 98416)

Snowpack data and temperature information in the form of degree-day calculations are analyzed for Paradise, Mt. Rainier for the weeks following the May 18, 1980 eruption of Mt. St. Helens. The figures are compared with similar computations for the preceding 25 years. The results show that the dark ash layer increased the snowmelt rate by some 40% over what would have been expected from ambient temperatures. (Snowmelt, ashfall, degree-days, comparisons)
J. Geophys. Res., Green, Paper 1C1349

3180 Water quality
OPTIMAL CONTROL OF RESERVOIR DISCHARGE QUALITY THROUGH SELECTIVE WITHDRAWAL
U. Fontane (Colorado State University, Ft. Collins, Colorado) J. Labadie and B. Loftis

A methodology combining simulation and optimization techniques is presented for determining optimal operational guidelines for selective withdrawal structures to meet downstream water temperature objectives. The goal is to develop operating rules that take into account anticipation of future critical temperature conditions that could occur. A one-dimensional reservoir thermal simulation model developed by the U. S. Army Engineer Waterways Experiment Station is used to simulate the thermal stratification cycle of a reservoir. The thermal stratification model is interfaced with a new method of formulating dynamic programming problems called objective-space dynamic programming to develop the optimal operation for each decision period. An advantage of the approach is that the thermal simulation model is retained in its original form, rather than having to be restructured to fit explicitly into the optimizing model. An objective function related to release temperature deviations from desired target levels is minimized over a portion of the stratification cycle. Application to a case study shows the potential for improved system performance using the dynamic programming technique, as compared to the normal myopic period by period operation. (Reservoir operation, selective withdrawal, thermal stratification, dynamic programming).
Water Resour. Res., Paper 1W1098

3190 Instruments and techniques
A PROBE METHOD FOR SOIL WATER SAMPLING AND SUBSURFACE MEASUREMENTS
W. D. Harrison (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701, U.S.A.) and T. E. Osterkamp

A technique employing light weight driving and sampling equipment to obtain interstitial soil water samples is described. It can also be used for hydraulic conductivity, temperature, and water pressure measurements. The sampler consists of a probe, with a shield and a porous metal filter, and a check valve which are connected to the surface by plastic tubing inside standard EW or A drill rod. The water sample is collected with a bailer lowered inside the tubing from the surface. The tubing can then be cleared and sealed without pulling the drill rod, and the sampler driven to the next depth. A method of estimating the probe shape factor is given. Some of the difficulties unique to sampling interstitial water in thawed subsea permafrost are discussed.
Water Resour. Res., Paper 1W1260

3197 General or miscellaneous
HIGHLY EFFICIENT, [illegible] TRANSPORT EQUATION [illegible]
K. O'Neill (U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH [illegible])

Transport problems with sharp fronts [illegible] convection often are a [illegible] computational method is beyond [illegible] one promising line of attack [illegible] problems [illegible] (MOC). Using [illegible] may concentrate computational effort where it is most appropriate, [illegible] reducing the effective magnitude of terms which cause trouble. In principle, [illegible] with finite difference, finite element, or other numerical methods, according to preference. [illegible] the particular finite element [illegible] here, mesh movement may be [illegible] space, so that physically fixed [illegible] remain fixed in the transformed [illegible] A simple finite difference [illegible] when the method is applied to the standard transport equation test case, great efficiency and accuracy are obtained in [illegible] steep fronts may be represented [illegible] oscillations, using space and time [illegible] beyond conventional [illegible] straints. More important problems [illegible] involving transport [illegible] larger spaces, [illegible] to operate, and hence [illegible] [illegible] achieved as during [illegible] nodes and time [illegible] time runs. [illegible] savings in [illegible] conventional [illegible] tive efficiency [illegible] problems would [illegible] case. (Convection, [illegible] moving mesh).
Water Resour. Res., Paper [illegible]

Meteorology

3715 Chemical composition and chemical interactions
TOTAL OZONE SEASONAL AND INTERANNUAL VARIATIONS DERIVED FROM THE 7 YEAR NIMBUS-4 BUV DATA SET
E. Hilsenrath (NASA/Goddard Space Flight Center, Laboratory for Planetary Atmospheres, Greenbelt, Maryland, 20771) and B. M. Schlesinger

Backscattered ultraviolet (BUV) data from the Nimbus-4 spacecraft for the period 1970 to 1977 have been recently processed to final form. This paper is based upon an analysis of all the total ozone available in the 7-year data set. The seasonal and interannual variations of total ozone over the globe are examined, using daily zonal means of 10° latitude bands and a time latitude cross section. A harmonic analysis was performed on the daily zonal means, and the amplitude, phase, and percentage of variance were computed for the annual, semi-annual, and higher harmonics for several years and for individual years. Many of the features observed earlier for the period 1970-1972, such as the asymmetry of the annual wave in the two hemispheres, persist over the longer data period. Variations with regular periods shorter than a few months were sought but none were evident systematically throughout the latitude zones. Examination of the zonal mean data with the mean annual wave removed revealed a clear quasibiennial oscillation (QBO) strongest in the tropics, where it is comparable to the annual wave, persisting to mid-latitudes in both hemispheres with some evidence of its existence at high latitudes. An estimation of the QBO period using a superposition analysis (for no more than three cycles) for each latitude zone revealed a decreasing period with latitude in both hemispheres. The maximum period of 27 months occurs in the tropics while the minimum in the Northern Hemisphere is about 20 months. This result suggests that the observed QBO in total ozone at high and low latitudes may not be directly related. This is of particular significance to studies of ozone trends since the result indicates interannual variations are latitude dependent.
J. Geophys. Res., Green, Paper 1C1232

3250 Hail in the atmosphere
A NOTE ON THE OBSERVED DIURNAL AND SEMIDIURNAL RAINFALL VARIATIONS
K. Hamilton (National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307)

Earlier investigations of the diurnal and semidiurnal rainfall variations are extended with an analysis of hourly rainfall data at [illegible] stations in the United States and Puerto Rico. Interesting findings include a confirmation of the remarkable tendency (observed earlier by Lindzen [1978] and Hamilton [1981]) for the semidiurnal component of tropical rainfall to peak at roughly [illegible] and 1530 local time. It also appears that [illegible] over the United States this [illegible] phase [illegible] slightly later) is quite typical of the midlatitude region as well. The significance of these findings for the theory of the semidiurnal atmospheric tide is discussed.
J. Geophys. Res., Green, Paper [illegible]

Mineralogy, Petrology, and Crystal Chemistry

4220 Descriptive mineralogy
PARASCHOLZITE, A NEW MINERAL FROM HAGENDORF, BAVARIA, AND ITS RELATIONSHIP TO SCHOLZITE
D.Sturman (Royal Ontario Museum, Toronto, Ontario, M5S 2C6, Canada) P. Dunn and R. Rouse

The new mineral parascholzite, $CaZn_2(PO_4)_2 \cdot 2H_2O$, from Hagendorf, Bavaria, is monoclinic, Cc or $C2/c$, with a 17.864, b 7.422, c 6.674 Å, β106°27'. It is dimorphous with scholzite, which is orthorhombic, $Pbc2_1$, with a 17.178, b 22.24, c 6.681. Scholzite and parascholzite form syntaxial intergrowth with (100) the composition plane. Much previously published scholzite data were obtained from these intergrowths or from parascholzite itself, which explain some of the confusion in the literature on scholzite. New data for scholzite are presented. Parascholzite is white to colorless with a white streak. The specific gravity is 3.12 (obs. and 3.10 (calc.). Hardness (Mohs) is 4. Optically it is biaxial (+) with 2V = 25°, α 1.587, β 1.589, γ 1.603; b=X and c∧Z = 13° in the acute angle between a and c. It is invariably twinned with (100) as both the twin and composition plane.
Am. Min. 66, July-August

4260 Paragenesis, petrography, and petrogenics
COMPOSITIONAL VARIATION IN NORMAL MORB FROM 22-25°N, MID-ATLANTIC RIDGE AND KANE FRACTURE ZONE
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Basalts dredged between 22°N and 25°N include samples from median valley walls, floor, and walls and intersections with the Kane Fracture Zone. All are "normal MORB" characterized by depletion in large-ion-lithophile elements. There are no significant chemical variations associated with age or location relative to the fracture zone and median valley. Detailed study of within-sample glass - whole rock relations shows that much of the chemical variation is explained by simple low-pressure fractionation. Magma mixing and variable depths of partial melting account for some additional geochemical complications. A common type of MORB from this area is suggested as the most likely candidate for primary magma; it may have separated from the mantle at pressures of 8-9 kb.
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